<u>- R E M A R K S / A R G U M E N T S -</u>

Claims 1 to 20 are pending in the present application. Claims 3 to 16, 19 and 20 are allowed. Claims 1, 2, 17 and 18 are rejected. Reconsideration of the rejections of claims 1, 2, 17 and 18 is respectfully requested in view of the following comments.

<u>Rejection of claims 1, 2, 17 and 18 under 35 USC §103(a) using Rioux et al. (US 5,946,645) in view of VanEssen et al. (US 6,591,004)</u>

Claims 1, 2, 17 and 18 are rejected for being obvious over Rioux et al. and VanEssen et al. The Applicants respectfully submit that the rejection is improper for the following reasons.

The Applicants would like to submit the following clarifications regarding the disclosures of Rioux et al. and of VanEssen et al. It is noted that Patrick Hébert, who is an inventor of the present application, is also an inventor of U.S. Patent No. 5,946,645 to Rioux et al.

Rioux et al. describe a method and apparatus for individually refining the alignment of arbitrary three-dimensional profiles. These profiles are range curves which are curves of three-dimensional points obtained on the surface of an object. The method operates on a set of these curves that are known in a common coordinate system. The method described relies on measuring the distance between each profile and every other profile in the set. This causes a combinatorial complexity of $O(N^{2)}$, where N is the number of profiles. The method therefore cannot be used with an arbitrarily high number of curves. It is restrained, in theory as well as in practice, to small surface sections with a limited number of profiles.

The Examiner states that Rioux et al. disclose constructing a volumetric <u>implicit</u> representation of the target surface in the form of a vector field. The Applicants disagree with this assertion.

In mathematics, an implicit function is a generalization for the concept of a function in which the dependent variable has not been given "explicitly" in terms of the independent variable. To give a function f explicitly is to provide a prescription for determining the value of the function y in terms of the input value x:

$$y = f(x).$$

By contrast, the function is implicit if the value of y is obtained from x by solving an equation of the form:

$$R(x,y) = 0.$$

(source: http://en.wikipedia.org/wiki/Implicit_function, Jan. 17, 2008)

Rioux et al. do not describe constructing a volumetric <u>implicit</u> representation of the target surface in the form of a vector field. Rioux et al. rather provide a set of three-dimensional profiles aligned relative to one another in a three-dimensional space. The Applicants submit that this is also not taught by VanEssen.

The Applicants agree with the Examiner that Rioux et al. do not teach reconstructing said target surface from the information contained in the vector field. More specifically, Rioux et al. do not describe any means for reconstructing the target surface from the three-dimensional profiles once their alignment has been refined. In fact, the surface representation is limited to a grid of crossing curves.

Also, contrary to what the Examiner states, Rioux et al. do not describe each vector in said vector field containing at least one of the distance to said target surface and the direction toward said target surface. Applicants submit that this is also not taught by VanEssen. Finally, the method and apparatus in Rioux et al. are limited to the processing of profiles (i.e. a set of three-dimensional points lying on an underlying curve). It is not possible to process unorganized clouds of points.

Regarding VanEssen et al., they describe an approach to extract a surface of the cerebral cortex and other complex structures in the brain in medical imaging. The input measurements are obtained from devices that measure <u>through a volume</u>. In this case,

a measure of the material type is obtained within each voxel of the volumetric grid throughout the whole slices of the volume. VanEssen et al. then generate a set of probabilistic values for the location of different compartments and their boundaries. Their set of filter operators is used to segment structures and extract adjoining structures within their probabilistic volumetric representation.

As mentioned above, VanEssen et al. do not describe each vector in said vector field containing at least one of the distance to said target surface and the direction toward said target surface. VanEssen et al. use a vector field for surface reconstruction but the vectors in the vector field of VanEssen et al. represent the density of the imaged object (see abstract of VanEssen et al.).

A vector field is a mathematical abstraction that can be defined in various contexts. In the current situation, a vector field is a vector function defined over a three-dimensional domain that is discretized in a volumetric grid of voxels. Each voxel contains a vector that is used to define a surface. Here ends the similarity on the mathematical foundation.

In VanEssen, the content of the vector field is developed for volumetric measurements as opposed to surface range measurements. This differs from having the vector field built from sets of three-dimensional entities collected on the target surface. These points are typically measured from range finders that cannot measure through the "opaque" surface.

As mentioned above, neither Rioux et al. nor VanEssen et al. describe each vector in said vector field containing at least one of the distance to said target surface and the direction toward said target surface. It is by encoding both the direction and the distance that the vector field makes it possible to integrate three-dimensional entities (i.e. unorganized clouds, three-dimensional curves or range images) with a complexity of O(N) where N is the number of three-dimensional entities. This makes it possible to eliminate the combinatorial explosion as the number of entities increases as found in Rioux et al. This vector field makes it possible to deal with target surfaces of arbitrary

size. Following this new approach, there is no need to explicitly compute the distance between three-dimensional entities. The alignment is performed within a volumetric vector field where the three-dimensional entities attract each other and contribute to defining the field. Even more interesting, the volumetric vector field is intrinsically a complete geometric shape representation in the form of an implicit surface. The surface model transcends the simple set of aligned three-dimensional entities. Finally, the zero set of the volumetric vector field implicitly encodes a model of the target surface. The zero set encompasses the three-dimensional positions in the vector field where the distance to the closest point on the surface is 0.

In view of the above, the Applicants respectfully submit that the rejection is improper and reconsideration is kindly requested.

It is believed that claims 1, 2, 17 and 18 are allowable over the prior art, and a Notice of Allowance is earnestly solicited.

Respectfully submitted,
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